

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
29 September 2005 (29.09.2005)

PCT

(10) International Publication Number
WO 2005/091004 A1

(51) International Patent Classification⁷: **G01R 31/06**,
G01M 15/00, G06F 17/10

(21) International Application Number:
PCT/CA2005/000438

(22) International Filing Date: 23 March 2005 (23.03.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/555,316 23 March 2004 (23.03.2004) US

(71) Applicant (for all designated States except US): **THE UNIVERSITY OF BRITISH COLUMBIA** [CA/CA];
Industry Liaison Office, Suite 103, 6190 Agronomy Road,
Vancouver, British Columbia V6T 1Z3 (CA).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MARTI, Jose, R.**
[CA/CA]; 4689 West 12th Avenue, Vancouver, British

Columbia V6R 2R7 (CA). **SRIVASTAVA, Krishan, D.**
[CA/CA]; 260, 256th Street, Aldergrove, British Columbia
V4W 2H8 (CA). **JIANG, Qiaoshu** [CN/CA]; 6C #738
14th Avenue, Southwest, Calgary, Alberta T2R 0N1 (CA).

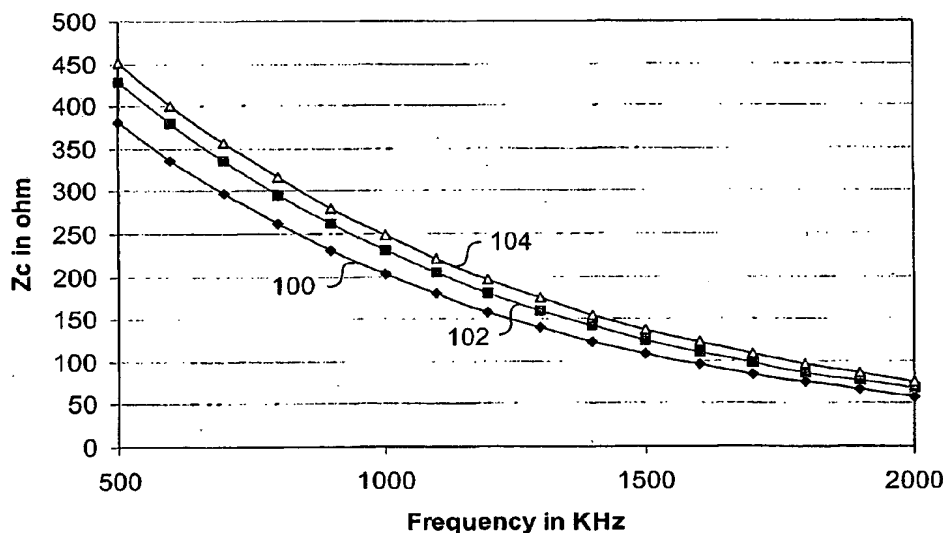
(74) Agents: **HUNG, Shin et al.**; Borden Ladner Gervais LLP,
World Exchange Plaza, Suite 1100, 100 Queen Street, Ot-
tawa, Ontario K1P 1J9 (CA).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ,
TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA,
ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: ELECTRIC WINDING DISPLACEMENT DETECTION METHOD AND APPARATUS



(57) Abstract: A method and system for obtaining the characteristic impedance of an electrical winding by measuring the input and output voltages and the currents within a winding across a low frequency range, and applying transmission line properties to model the winding. The characteristic impedance (Z_c) is directly proportional to the capacitance of the winding, and is independent of external circuits. Thus any changes to Z_c will reflect movements of the winding that would affect the capacitance. Because Z_c has a smooth and robust monotonical relationship with frequency of the applied signal, the resulting curve is exponential in shape. A relative comparison between Z_c curves will provide a clear indication of the overall axial or radial winding movements, or winding faults, which can be used to assess the overall health of the winding.

WO 2005/091004 A1



European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA,

- of inventorship (Rule 4.17(iv)) for US only

Published:

- with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.